

## FERTILIZER

fertilize an egg. The *zygote* (fertilized egg) becomes a new animal.

GEORGE W. BEADLE

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**FERTILIZER** is a substance that is added to soil to help plants grow. Farmers use various kinds of fertilizers to produce abundant crops. Home gardeners use fertilizers to raise large, healthy flowers and vegetables. Landscapers spread fertilizers on lawns and golf courses to help grow thick, green grass.

Fertilizers contain *nutrients* (nourishing substances) that are essential for plant growth. Some fertilizers are made from organic waste, such as manure or sewage. Others are manufactured from certain minerals or from synthetic compounds produced in factories.

Man has used fertilizer for thousands of years—even though he once did not know why it was good for plants. Long before he understood plant nutrition, he noticed that animal droppings, wood ashes, and certain minerals helped plants thrive. During the 1800's and early 1900's, scientists discovered that certain chemical elements were essential for plant nutrition.

Today, farmers throughout the world use billions of dollars worth of fertilizer yearly. Fertilized crops probably make up about a fourth of the world's total crop production. Crop yields would be much lower without fertilizer, and greater amounts of land and manpower would be needed to produce the same quantity of food and fiber.

### The Importance of Fertilizer

Green plants produce the food they use for growth. They produce it by means of the process of photosynthesis (see PHOTOSYNTHESIS). To make this food, plants require large amounts of nine chemical elements—carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulfur, calcium, and magnesium. They also must have smaller amounts of several other elements. These elements, called *micronutrients* because so little of each is needed, include boron, copper, iron, manganese, molybdenum, and zinc.

Air and water provide most of the carbon, hydrogen, and oxygen that green plants need for growth. The other elements must come chiefly from the soil.

The elements plants receive from soil are normally provided by decaying plant and animal matter and dissolved minerals. But sometimes soil does not have enough of these substances, resulting in a need for fertilizer. The harvest of crops, for example, involves removing plants from the soil before they die and decay. The soil does not receive the mineral elements contained in the crops, and so fertilizer must be added to supply them. Nitrogen, phosphorus, and potassium are the elements in which soil is most frequently deficient. They are the main fertilizer elements.

### Kinds of Fertilizers

There are two chief kinds of fertilizers, *mineral* and *organic*. Manufacturers produce mineral fertilizers from

certain minerals or synthetic substances. Organic fertilizers come from decayed plant or animal matter.

**Mineral Fertilizers** are the most widely used fertilizers. They supply three main elements: (1) nitrogen, (2) phosphorus, and (3) potassium.

**Nitrogen Fertilizers**, the most widely used mineral fertilizers, are produced mainly from ammonia gas. Manufacturers use ammonia in making such liquid fertilizers as anhydrous ammonia and aqua ammonia. They also use it in producing solid fertilizers, such as ammonium sulfate, ammonium nitrate, ammonium phosphate, and an organic compound called *urea*. Each of these fertilizers provides the soil with large amounts of nitrogen. Some of them, including ammonium sulfate and ammonium phosphate, furnish other elements as well.

**Phosphorus Fertilizers**, also called *phosphates*, are made from the mineral apatite. Finely ground apatite may be applied to soil as a solid fertilizer called *rock phosphate*. Apatite also may be treated with sulfuric acid or phosphoric acid to make liquid fertilizers called *superphosphates*.

**Potassium Fertilizers** come largely from deposits of potassium chloride. Manufacturers mine the deposits or extract them with water to produce such fertilizers as potassium chloride, potassium nitrate, and potassium sulfate.

**Other Mineral Fertilizers** provide soil with various elements. Those made from gypsum, for example, supply sulfur. Manufacturers also produce fertilizers that provide specific micronutrients.

**Organic Fertilizers** are made from a variety of substances, including manure, plant matter, sewage water, and packing house wastes. These fertilizers contain a smaller percentage of nutrients than do mineral fertilizers. Therefore, they must be used in larger quantities to obtain the same results. Some organic fertilizers may also cost more. But they solve a disposal problem because organic waste has few uses other than as fertilizer. Plant matter is used as fertilizer in two main ways, (1) as a compost pile or (2) as green manure.

A compost pile consists of alternate layers of plant matter and soil. Fertilizer mixed with lime is also usually added. The pile is allowed to decay for several months before being used as fertilizer. See COMPOST.

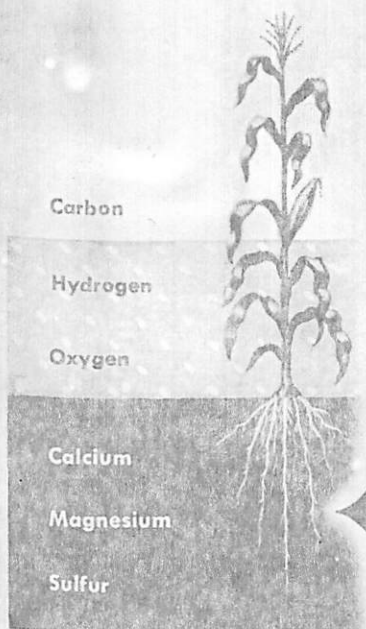
Green manure consists of certain crops that farmers use as fertilizer. For example, some plants have bacteria in *nodules* (knotlike growths) on their roots. These bacteria take nitrogen out of the air. Such plants, called *legumes*, include alfalfa, beans, and clover. Farmers may plant a crop of legumes and then plow the young plants into the soil. As the plants decay, nitrogen returns to the soil and enriches it for other crops.

### The Fertilizer Industry

The United States manufactures more fertilizer than any other country. It produces about \$5½ billion worth of fertilizer annually and exports about \$680 million of it. About 95 per cent of the fertilizer produced in the world is used on farm crops. Vol F world BK

**Raw Materials** for fertilizer come from several sources. Ammonia, the basic source of nitrogen fertilizer, is formed by combining nitrogen from the air with hydrogen from natural gas. Several U.S. oil firms produce ammonia because they have supplies of natural gas.

The United States has about 40 per cent of the



### Some Essential Elements for Plant Growth

Green plants need various chemical elements to grow and reproduce. Air and water supply carbon, hydrogen, and oxygen. The soil usually contains sufficient calcium, magnesium, sulfur, and micronutrients for plant growth. Additional nitrogen, phosphorus, and potassium are the most common needs that must be provided by fertilizers. The chief sources of these elements are listed below.

#### Nitrogen

Most nitrogen fertilizer is either liquefied ammonia or a product made from ammonia, such as ammonium sulfate or ammonium nitrate. Manure and other organic fertilizers also contain nitrogen.



#### Phosphorus

The mineral apatite is the chief source of phosphorus fertilizers. Apatite is sometimes finely ground and applied to the soil, but more often it is treated with acids to produce liquid fertilizers called superphosphates.



#### Potassium

Potassium chloride mined from mineral deposits is the chief potassium fertilizer. Other potassium fertilizers include potassium nitrate and potassium sulfate.



world's supply of phosphate rock. The main sources are in Florida, Idaho, Missouri, Montana, North Carolina, Tennessee, Utah, and Wyoming. Morocco and Russia rank as the chief suppliers after the United States.

The largest deposits of potassium chloride, the major source of potassium fertilizer, occur in Canada and Russia. Canada furnishes about 75 per cent of the potassium chloride used in the United States. Potassium chloride is mined in several states, including California, New Mexico, and Utah.

**Production and Sale.** Fertilizer is produced and sold in four basic forms. *Straight goods fertilizer* is any chemical compound that contains one or two fertilizer elements. *Bulk blend fertilizer* is a mixture of straight goods in certain proportions. *Manufactured fertilizer* consists of two or more chemicals that are mixed and then formed into small grains. Each grain contains nitrogen, phosphorus, and potassium and perhaps certain micronutrients. *Liquid fertilizer* consists of one or more fertilizer materials dissolved in water. It may be sprayed on plants or soil, injected into soil, or added to irrigation water.

Most fertilizers release their plant nutrients into the soil almost immediately. Manufacturers also produce a special type of fertilizer, called *slow-release fertilizer*, that gives up its nutrients gradually. This type has been found useful when plants need a constant supply of nutrients over a long period of time.

**Problems of the Fertilizer Industry.** Every year, large amounts of fertilizer must be produced to meet the world's growing need for food. The fertilizer industry tries to match its production with this need. If it does not do so, severe food shortages might result.

A shortage of raw materials could cause a low supply of fertilizer. Some materials, such as natural gas and phosphorus, have uses other than in making fertilizer. Their use by other industries could cause a shortage for fertilizer manufacturers.

The mining and processing of the raw materials needed to make fertilizer may damage the environment. Many minerals used in making fertilizer come from open-pit mines, which cause large unproductive areas unless properly landscaped. In addition, the excessive use of fertilizer can contribute to water pollution. For example, erosion may carry fertilized soil into lakes and streams. The nutrient elements in the soil then increase the growth of simple plants called *algae* in the water. When the algae die, they produce large amounts of waste. As the waste decays, it uses up the oxygen supply of the water.

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#### Related Articles in World Book include:

##### FERTILIZER MATERIALS

Ammonia	Guano	Nitrogen
Anhydrous	Lime	Phosphate
Ammonia	Limestone	Phosphoric Acid
Ash	Manure	Phosphorus
Calcium	Marl	Potassium
Compost	Mulch	Sulfur
Dolomite	Nitrate	Urea

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Agricultural Education  
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Eutrophication  
Soil (Characteristics of Soil)  
Water Pollution

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# Natural Fertilizers (nourishing Substances)

Organic:

Leaves = organic

Cow Manure

Horse "

Chicken "

Bat " (Guano)

Sewage

Compost

Mulch

What could be done to commercialize and industrialize Fertilizers for our Region

## Mineral Fertilizers:

Ammonia & Anhydrous

Ash

Calcium

Dolomite

Lime

Limestone

Marl

Nitrate

Nitrogen

Phosphate

Phosphoric Acid

Phosphorus

Potassium

Sulfur

Urea

# Natural Fertilizers

Organic:

Cow Manure

" Horse

" Chicken

" Bat

Seeds

Mineral Fertilizers:

Ammonia & Anhydrous  
Potassium  
Sulfur  
Gypsum

Phosphoric Acid  
Superphosphate  
Hydroxyapatite  
Mellite  
Limestone  
Dolomite  
Gypsum  
Potassium  
Sulfur  
Gypsum